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BIFOCAL CORNEAL CONTACT LENS

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This invention relates to a corneal contact lens which is novel in that it is bifocal in character. Specifically the lens has one zone of one power and another zone of a different power. One zone may be an annular outer zone surrounding an inner zone.

One object of the invention is to provide a bifocal corneal contact lens in which the zones may be differently powered for both far and near visual correction, thereby considerably extending the usefulness of corneal contact lenses which at present are primarily designed with but a single power for compensating for hyperopia or myopia by modifying the effective focal length of the lens of the eye so that the image within a certain range of vision is focused on the retina rather than behind it or in front of it.

Another object is to provide a bifocal corneal contact lens which can be designed for use by hyperopes for both far and near visual correction by providing the lens with a central zone of relatively low positive power for normal distant seeing and a relatively higher positive powered outer zone for close seeing such as reading and the like, and in which the lens is subject to central vision through the central zone when the eye looks straight ahead, but due to lag of the lens with respect to the cornea when the eye is cast downwardly the outer zone of the lens is then subject to central vision, thus providing the desired greater magnification in the downcast position of the eye regardless of the circumferential position of the contact lens which cannot be kept in one position against rotation as in ordinary bifocal spectacles but rather tends to rotate with each blinking of the eyelid. The lens can also be designed for myopes by providing a negative central zone for distant vision rather than a positive central zone as thus far referred to. The outer zone would be a different power than the inner zone, and the lens may be trifocal in cases of extreme hyperopia or myopia. The outer zone or zones may be either positive or negative in effect as required for the particular patient to which they are fitted.

Still another object is to provide a corneal contact lens having dual zones of power either both positive, both negative, or one positive and the other negative, so that rays of light passing through the lens are magnified or minified to various selected degrees by the different zones of the lens for impingement upon different portions of the retina such as the portion thereof involving central vision as distinguished from the remainder of the retinal area involved in peripheral vision.

A further object is to provide a dual-zone corneal contact lens in which the inner zone of the lens may not have magnifying or minifying power for distant vision as none is required, while the outer zone is powered to correct for visual deficiency, or the zones may be reversed for certain patients.

Still a further object is to provide a corneal contact lens that provides two or more different zones (not necessarily concentric with each other) for correction for visual deficiency at different distances of subjects from the eye.

An additional object is to provide a multi-zone corneal contact lens having a zone of one power and one or more other zones of different powers which do not necessarily surround the first zone, said lens being thereby useful in

connection with special activities of the patient wearing the lens.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my bifocal corneal contact lens, whereby the objects above contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in detail on the accompanying drawing, wherein:

FIG. 1 is a vertical diagrammatic cross-section through the human eye showing a typical form of my bifocal corneal contact lens in wearing position thereon with the eye looking straight ahead for central vision through the central zone of the lens;

FIG. 2 is a front elevation of the lens shown in FIG. 1;

FIG. 3 is a sectional view somewhat similar to FIG. 1 in which the eye has shifted to a downcast position and the outer zone of the lens is in operation as far as central vision is concerned;

FIG. 4 is an enlarged cross-section of the lens including reference arcs to explain the difference in power of the inner and outer zones of the lens, to illustrate a central zone of relatively low plus power and an outer zone of relatively high plus power for use by a hyperope to correct for both far and near vision; and

FIGS. 5, 6 and 7 are cross-sections of lenses somewhat similar to FIG. 4 and showing different combinations of powers in the central and outer zones of the lenses, the curvatures of the surfaces and the thickness of the lenses being exaggerated to better illustrate the problems involved.

In FIG. 1 I have used the reference numeral **10** to indicate in general the cornea of the eye. The cornea has a central apical area which is substantially spherical and a peripheral area surrounding the central area which departs from the spherical shape of the apical area, being somewhat flatter or of greater radius, the radius increasing (but somewhat irregularly) away from the apical area.

Surrounding the cornea **10** is the sclera **12** or white portion of the eye. The transition from cornea to sclera is the limbus which defines the limbal area within which a corneal contact lens is usually positioned. Just back of the cornea **10** is the iris or diaphragm **14** which defines the iris opening or pupil **16**. The sensory end organ of the eye is the retina **20** which includes a central vision area **22** comprising a group of visual cells surrounding a central optical rod or rhabdom (which is usually termed the fovea centralis). The rest of the retina **20** involves peripheral vision.

Man has "camera" eyes including a lens **18** suspended between a chamber **26** containing vitreous humour and a chamber **28** containing aqueous humour. The rear of the chamber **26** is lined with the retina **20**. The cornea **10** acts as a lens in front of the chamber **28** and of course is transparent, its apparent color being that of the iris **14**. The iris is activated bu muscles which control the size of its central opening or pupil **16** through which light enters the eye. Light passing through the lens **18** is focused on the retina as an image and the varied stimuli act on nerve endings of the retina to result in a definite mental picture transmitted to the brain by the optic nerve **24**. The eyes are provided with muscles which direct them toward objects to be observed. They also have muscular focusing devices which control the curvature of the lens **18** and thus its focus with respect to the retina.[1]

In normal eyes the image is focused sharply on the retina by automatic reflex action of the muscles for the lens **18** but the ability to focus generally deteriorates

[1] Van Nostrand's Scientific Encyclopedia, 2nd ed., 1947, page 555.